

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Pfister et al. Confirmation No.: 7438

Application No.: 10/783,542 Art Unit: 2621

Filing Date: February 20, 2004 Examiner: C. Anyikire

Title: 3D TELEVISION SYSTEM AND METHOD

AMENDMENT

Dear Sir:

This Amendment is in response to a Final Office Action dated June 3, 2008.

Amendments to the Claims

1 1. (currently amended) A three-dimensional television system, comprising:
2 an acquisition stage, comprising:
3 a plurality of video cameras, each video camera configured to acquire
4 a video of a dynamically changing scene in real-time;
5 means for synchronizing the plurality of video cameras; and
6 a plurality of producer modules connected to the plurality of video
7 cameras, the producer modules configured to compress the
8 videos to compressed videos and to determine viewing
9 parameters of the plurality of video cameras, in which the
10 viewing parameters include a position, orientation, field-of-
11 view, and focal plane of each video camera;
12 a display stage, comprising:
13 a plurality of decoder modules configured to decompress the
14 compressed videos to uncompressed videos;
15 a plurality of consumer modules configured to generate a plurality of
16 output videos from the decompressed videos according to the
17 viewing parameters;
18 a controller configured to broadcast the viewing parameters to the
19 plurality of decoder modules and the plurality of consumer
20 modules;
21 a three-dimensional display unit configured to concurrently display
22 the plurality of output videos onto a single display surface
23 according to the viewing parameters; and

24 means for connecting the plurality of decoder modules, the plurality
25 of consumer modules, and the three-dimensional display unit;
26 and

27 a transmission stage, connecting the acquisition stage to the display stage,
28 configured to transport the plurality of compressed videos and the viewing
29 parameters.

1 2. (currently amended) The system of claim 1, further comprising a plurality of
2 cameras configured to acquire calibration images displayed on the display surface
3 of the three-dimensional display unit to determine the viewing parameters.

1 3. (original) The system of claim 1, in which the display units are projectors.

1 4. (original) The system of claim 1, in which the display units are organic light
2 emitting diodes.

1 5. (original) The system of claim 1, in which the three-dimensional display unit
2 uses front-projection.

1 6. (original) The system of claim 1, in which the three-dimensional display unit
2 uses rear-projection.

1 7. (original) The system of claim 1, in which the display unit uses two-dimensional
2 display element.

1 8. (previously presented) The system of claim 1, in which the display unit uses a
2 flexible fabric.

9. (canceled)

1 10. (original) The system of claim 1, in which different output images are
2 displayed depending on a viewing direction of a viewer.

1 11. (previously presented) The system of claim 1, in which static view-dependent
2 images of an environment are displayed such that a display surface of the display
3 unit disappears.

1 12. (previously presented) The system of claim 1, in which dynamic view-
2 dependent images of an environment are displayed such that a display surface of
3 the display unit disappears.

1 13. (original) The system of claim 11 or 12, in which the view-dependent images
2 of the environment are acquired by a plurality of cameras.

1 14. (original) The system of claim 1, in which each producer module is connected
2 to a subset of the plurality of video cameras.

1 15. (original) The system of claim 1, in which the plurality of video cameras are in
2 a regularly spaced linear and horizontal array.

1 16. (original) The system of claim 1, in which the plurality of video cameras are
2 arranged arbitrarily.

1 17. (original) The system of claim 1, in which an optical axis of each video camera
2 is perpendicular to a common plane, and the up vectors of the plurality of video
3 cameras are vertically aligned.

1 18. (original) The system of claim 1, in which the viewing parameters include
2 intrinsic and extrinsic parameters of the video cameras.

1 19. (original) The system of claim 1, further comprising:
2 means for selecting a subset of the plurality of cameras for acquiring a subset
3 of videos.

1 20. (original) The system of claim 1, in which each video is compressed
2 individually and temporally.

21. (canceled)

1 22. (previously presented) The system of claim 1, in which the controller
2 determines, for each output pixel $o(u, v)$ in the output video, a view number v and a
3 position of each source pixel $s(v, x, y)$ in the decompressed videos that contributes
4 to the output pixel in the output video.

- 1 23. (original) The system of claim 22, in which the output pixel is a linear
2 combination of k source pixels according to

3
$$o(u,v) = \sum_{i=0}^k w_i s(v,x,y),$$

- 4 where blending weights w_i are predetermined by the controller based on the
5 viewing parameters.

- 1 24. (original) The system of claim 22, in which a block of the source pixels
2 contribute to each output pixel.

- 1 25. (original) The system of claim 1, in which the three-dimensional display unit
2 includes a display-side lenticular sheet, a viewer-side lenticular sheet, a diffuser,
3 and substrate between each lenticular sheets and the diffuser.

- 1 26. (original) The system of claim 1, in which the three-dimensional display unit
2 includes a display-side lenticular sheet, a reflector, and a substrate between the
3 lenticular sheets and the reflector.

- 1 27. (previously presented) The system of claim 1, in which an arrangement of the
2 cameras and an arrangement of the display units, with respect to the display unit,
3 are substantially identical, and the number of cameras and the number of display
4 units is greater than two.

- 1 28. (previously presented) The system of claim 1, in which the plurality of cameras
2 acquire the video of high dynamic light-fields.

- 1 29. (previously presented) The system of claim 1, in which the display units
- 2 display the output videos as high dynamic light-fields.

30. (canceled)

31. (canceled)

Remarks

Claims 1-8 and 10-29 are pending in the application. Claims 1-8 and 10-29 are rejected. All rejections are respectfully traversed.

Claims 1-3, 5-24 and 27 are rejected under 35 U.S.C. 102(b) as being anticipated by Ritchey, U.S. Patent No. 5,495,576 (Ritchey).

Ritchey describes virtual model-based virtual image rendering. Visual information is acquired using a camera, and shape information is acquired using radar (column 10, lines 17-25). Following acquisition of the sensor signals, Ritchey constructs a 3D virtual model (see Abstract, “The computer processor integrates the sensor signals, processes signals as a virtual model...” and column 9, lines 6-14).

Depending on the actions of a user, the 3D model is updated, for example, by moving a virtual object or changing the viewpoint of the display (column 9, lines 46-58), and virtual images are generated from the virtual model and rendered on a display (column 20, lines 46-50).

Ritchey generates a virtual model from sensor signals, and then generates virtual images from the virtual model. The claimed output video is generated from a compressed version of a video acquired of a dynamically changing scene.

Regarding claim 1, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera.

As the displayed virtual images of Ritchey are entirely virtual model-based, there is no need for Ritchey to determine viewing parameters of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera. All of the information Ritchey requires to display an image is determined by sampling the 3D model (column 2, lines 30-39). There is no mention of determining a position, orientation, field-of-view, or focal plane of a camera anywhere in Ritchey. At column 11, lines 55-61, and column 12, lines 1-9, Ritchey describes internal (intrinsic) camera parameters, such as chrominance, luminance, hue, and intensity, and additional hardware components that may be added to a camera. These are not viewing parameters, and certainly are not a position, orientation, field-of-view, and focal plane of each camera as claimed.

In addition, Ritchey fails to teach the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters.

As explained above, Ritchey fails to teach claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera. Therefore, Ritchey cannot teach a plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos *according to the viewing parameters*.

Furthermore, all of the information Ritchey requires to display his virtual image is determined by sampling the 3D virtual model. Depending on the actions of a user,

Ritchey updates and samples the 3D virtual model to determine what virtual images to display (column 20, lines 46-56). At column 22, lines 45-49, Ritchey describes determining a perspective projection *relative to a user's head and eyes*. This is not equivalent to generating a plurality of output videos according to the viewing parameters. As claimed, viewing parameters include position, orientation, field-of-view, and focal plane of each *video camera* used to acquire the videos, and not of a user viewing the videos. Ritchey cannot anticipate the claimed invention

Regarding claim 2, Ritchey fails to teach a plurality of cameras configured to acquire calibration images displayed on the display surface of the three-dimensional display unit to determine the viewing parameters. At column 11, lines 61-63, Ritchey describes compressing a plurality of images into a single frame. Examples of these single frames are shown in Figs. 9a, 9b, and 10 of Ritchey, see also column 12, lines 30-34 and lines 49-54. These images cannot be used to determine viewing parameters including position, orientation, field-of-view, and focal plane of each video camera. Additionally, these images are not calibration images. Calibration images, as known in the art, are used to compare a device or the output of an instrument to a standard having known measurement characteristics. In an embodiment of the invention, calibration images are used to determine viewing parameters for generating a plurality of output videos, see Specification, paragraphs [092]-[094]. There is nothing in Ritchey that teaches the use of calibration images as claimed.

Regarding claims 3 and 5-8, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and

focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the display units as claimed in claims 3 and 5-8.

Regarding claims 10-13, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the display of view-dependent images as claimed in claims 10-13.

Regarding claim 14, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising producer modules connected to a subset of the plurality of video cameras as claimed in claim 14.

Regarding claims 15-17, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in

which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the arrangement of video cameras as claimed in claims 15-17.

Furthermore, the cameras depicted in Fig. 17 are not in a regularly spaced linear and horizontal array as claimed in claim 15. Each camera in that figure is shown to be acquiring a different side of an object, see “Side A” through “Side F” clearly marked in Figure 17; column 10, lines 32-34; and Fig. 6. This is impossible with a regularly spaced linear and horizontal array as claimed in claim 15.

At column 12, lines 44-47, Ritchey describes optical fiber bundles used to transmit images “*of various sides of the subject*” (see lines 32-34) to the light sensitive recording surface of a camera. Acquiring images of various sides of an object, as described in Ritchey, requires a camera arrangement that can receive light from all sides of an object. This cannot be done with the camera arrangement as claimed in claim 17. Although the fiber optic cables can be twisted to achieve the described alignment *for the cables themselves*, this does not teach an optical axis of *each video camera* perpendicular to a common plane, and the up vectors *of the plurality of video cameras* being vertically aligned as claimed in claim 17. Again, it is clear that Ritchey does not describe a linear or quasi-linear array of cameras as claimed.

Regarding claim 18, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in

which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the viewing parameters as claimed in claim 18. Furthermore, as explained above, Ritchey does not teach *extrinsic* parameters, *i.e.*, parameters determined by camera placement as opposed to internal parameters determined by camera hardware, at column 11, lines 55-63, and column 12, lines 3-11.

Regarding claim 19, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the selection of a subset of cameras as claimed in claim 19.

Regarding claim 20, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the

claimed invention further comprising the compression of videos as claimed in claim 20.

Regarding claims 22-24, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the output pixel processing as claimed in claims 22-24.

Regarding claim 27, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the arrangement of video cameras and display unit as claimed in claim 27.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ritchey.

Regarding claim 4, Ritchey fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane,

of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising organic light emitting diodes as claimed in claim 4.

Claims 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ritchey, in view of Ezra et al., U.S. Patent No. 5,703,717 (Ezra).

Regarding claims 25 and 26, the combination of Ritchey and Ezra fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the lenticular display units as claimed in claims 25 and 26.

Claims 28 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ritchey, in view of Nayar et al., U.S. Patent Application Publication No. 2004/0070565 (Nayar).

Regarding claims 28 and 29, the combination of Ritchey and Nayar fails to teach the claimed producer modules configured to determine viewing parameters of the plurality of video cameras, in which the viewing parameters include a position, orientation, field-of-view, and focal plane, of each video camera, and the claimed plurality of consumer modules configured to generate a plurality of output videos

from the decompressed videos according to the viewing parameters. Therefore, Ritchey cannot anticipate the claimed invention further comprising the acquisition and display of high dynamic lightfields as claimed in claims 28 and 29.

It is believed that this application is now in condition for allowance. A notice to this effect is respectfully requested. Should further questions arise concerning this application, the Examiner is invited to call Applicant's attorney at the number listed below. Please charge any shortage in fees due in connection with the filing of this paper to Deposit Account 50-0749.

Respectfully submitted,

/Clifton D. Mueller/

Clifton D. Mueller
Attorney for the Assignee
Reg. No. 57,836

Mitsubishi Electric Research Laboratories, Inc.
201 Broadway, 8th Floor
Cambridge, MA 02139
Telephone: (617) 621-7517
Customer No. 22199